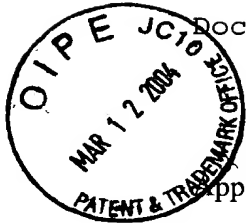


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PATENT

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

Applicants: DENBAARS et al.

Examiner: Baumeister

Serial No. 09/528,262

Art Unit: 2815

Filing Date: March 17, 2000

For: MULTI ELEMENT, MULTI COLOR SOLID STATE LED

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P.O. Box 1450  
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TRANSMITTAL OF APPEAL BRIEF

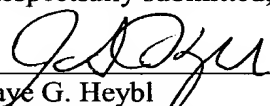
Sir:

Transmitted herewith in triplicate is an Appeal Brief for this application, with respect to the Notice of Appeal filed on January 13, 2004.

Enclosed is our check No. 21514 in the amount of \$330.00 reflecting the filing fee. If any additional fee is required, charge Account No. 11-1580. A duplicate of this transmittal is attached.

Respectfully submitted,

Dated: 3/12/04

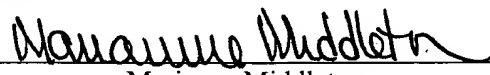
  
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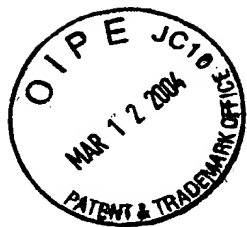
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CERTIFICATE OF MAILING

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3/12/04  
Date

  
Marianne Middleton



IN THE UNITED STATES PATENT AND TRADEMARK OFFICE  
BEFORE THE BOARD OF PATENT APPEALS AND INTERFERENCES

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Inventor : Steven P. Den Baars  
Serial No.: 09/528,262  
Filed : March 17, 2000  
Examiner : Baumeister, Bradley Art Unit: 2815  
Title : **MULTIPLE ELEMENT, MULTIPLE COLOR SOLID  
STATE LED**

ATTENTION: Board of Patent Appeal and Interferences

**APPELLANT'S BRIEF (37 C.F.R. § 1.192)**

This brief is in furtherance of the Notice of Appeal, filed in this case on January 13, 2004.

The fees required under §1.17, and any required petition of time for filing this brief and fees therefore, are dealt with in the accompanying TRANSMITTAL OF APPEAL BRIEF. This brief is transmitted in triplicate pursuant to 37 C.F.R. §1.192(a).

This brief contains these items under the following headings, and in the order set forth below pursuant to 37 C.F.R. §1.192(c).

- I. REAL PARTY IN INTEREST
- II. RELATED APPEALS AND INTERFERENCES
- III. STATUS OF CLAIMS
- IV. STATUS OF AMENDMENTS
- V. SUMMARY OF INVENTION
- VI. ISSUES
- VII. GROUPING OF CLAIMS
- VIII. ARGUMENTS
- IX. APPENDIX OF CLAIMS INVOLVED IN THE APPEAL

The final page of this brief bears the practitioner's signature.

**I. REAL PARTY IN INTEREST**  
(37 C.F.R. §1.192(c)(1))

The real party in interest is Cree, Inc., Durham, North Carolina, the owner and assignee of the subject application.

**II. RELATED APPEALS AND INTERFERENCES**  
(37 C.F.R. §1.192 (c)(2))

There are no known related appeals or interferences.

**III. STATUS OF CLAIMS**  
(37 C.F.R. §1.192(c)(3))

This is an appeal from the Examiner's final rejection of Claims 4-7, 9, 14, 15, 24, 30, 31, 33-42, 46, 47, 54, 55. Claims 16, 25-29, 43, 44, and 48-53 have been withdrawn from consideration. No claims have been allowed.

**IV. STATUS OF AMENDMENTS**  
(37 C.F.R. §1.192(c)(4))

No amendments were filed after the final rejection of November 14, 2003.

**V. SUMMARY OF THE INVENTION**  
(37 C.F.R. §1.192(c)(5))

a. The Problems Faced By The Prior Art

Light emitting diodes (LEDs) and lasers are in a class of light emitting solid state devices that convert electric energy to light. They generally include one or more active layers of semiconductor material sandwiched between oppositely doped layers. When a bias is applied across the doped layers, holes and/or electrons are injected into the active layer where they recombine to generate light. Light can be emitted omnidirectionally from the active layer and from other surfaces of the light emitter. The useful light is generally emitted in the direction of the emitter's top surface, which is usually p-type.

One disadvantage of conventional LEDs is that a single LED cannot generate white light from its active layers. One way to produce white light from conventional LEDs, however, is to combine different colors from different LEDs. For example, the light from red, green, and blue LEDs, or blue and yellow LEDs can be combined to produce white light, so in conventional multi-color LED displays, different LEDs must be included to generate white or other colors of light.

One disadvantage of this approach is that it requires the use of multiple LEDs to produce a single color of light, which increases costs. In addition, different colors of light are often generated from LEDs made from different material systems, which can require complex fabrication steps to combine in one device. The resulting

devices also use complicated control electronics since the different LED types typically use different control voltages. Long term wavelength and stability of these devices is also degraded by the different aging behavior of the different LEDs. The aging behavior depends on the material system used to make the LED.

More recently, the light from a single blue emitting LED has been converted to white light by surrounding the LED with a yellow phosphor, polymer, or dye. The surrounding material downconverts the wavelength of some of the LED light, changing its color. For example, if a nitride based blue emitting LED is surrounded by a yellow phosphor, then some of the blue light will pass through the phosphor without being changed while the remaining light will be downconverted to yellow. The LED will emit both blue and yellow light, which combine to produce white light.

One disadvantage of this approach is that the addition of the phosphor around the LED results in a more complex device that requires a more complex manufacturing process. In addition, the overall light emitting efficiency is reduced due to the absorption in the phosphor and the stokes shift from blue to yellow. Conventional blue LEDs also operate from a relatively low supply current that results in a light that is too dim for many lighting applications. This problem is compounded by the absorption of some of the blue light by the downconverting material used in generating white light from blue. For blue LEDs to provide a bright enough light source for room illumination, the current applied to the LED must be increased from the conventional 20-60 mAmps to 0.8-1 Amp. At this current, LEDs become very hot and any material surrounding the LED will also become hot. The heat can damage the downconverting material surrounding the LED, degrading its ability to downconvert the LED's light. The heat can also

present a danger of burning objects that are near or in contact with the LED.

b. The Embodiments Provided By The Appealed Claims

The present invention provides LEDs that are grown on substrates doped with one or more rare earth or transition elements. The LED relies on the light absorption and emission properties of the doped substrate and different combinations of light from the LED and its substrate that can produce different colors of light, such as white light.

Pursuant to independent claim 9, one embodiment of an LED according to the present invention it comprises an active layer, and a pair of oppositely doped layers on opposite sides of the active layer which cause the active layer to emit omnidirectional light at a predetermined wavelength in response to an electrical bias across the doped layers. The LED further comprises a doped substrate, with the active and doped layers disposed successively on the substrate such that the substrate absorbs at least some of the light from the active layer and re-emits omnidirectional light at a different wavelength. The LED emits a combination of light from the substrate and the active layer. The active layer emits yellow light and substrate comprises sapphire doped with chromium such that the substrate absorbs some of the yellow light and re-emitting red light.

Pursuant to independent claim 14, another embodiment of an LED according to the present invention comprises an active region and a pair of oppositely doped layers arranged similarly to those in claim 9. The LED also includes a doped substrate with the active region and doped layers disposed successively on the substrate such that the substrate absorbs at least some of the light from the active region. The substrate is doped throughout with a

plurality of impurities such that the impurities simultaneously absorb the light of the active region and each re-emits a respective color of light.

Pursuant to independent claim 30, one embodiment of a nitride based LED according to the present invention comprises a plurality of active layers each of which is capable of emitting light at a predetermined wavelength. It further comprises a means for selectively causing each of the plurality of active layers to emit light alone or in combination with others of the plurality of active layers. It comprises a doped substrate with the plurality of active layers arranged vertically on the substrate with a plurality of doped semiconductor layers. Each of the active layers is sandwiched between two doped layers. The substrate absorbs at least some of said light from at least one of the plurality of active layers and re-emits light at a different wavelength.

Pursuant to independent claim 41 another embodiment of an LED according to the present invention comprises an active layer and a pair of oppositely doped layers on opposite sides of the active layer which cause the active layer to emit light at a predetermined wavelength in response to an electrical bias across the doped layers. The LED further comprises a doped substrate. With the active layer and doped layers arranged in a stack on the substrate. The substrate absorbs at least some of the light from the active layer and re-emitting light at a different wavelength. The substrate is doped throughout with a plurality of impurities such that the substrate absorbs the light from the active layer, and re-emits more than one color of light.

Pursuant to claim 42, another embodiment of an LED according to the present invention comprises an active layer, a pair of oppositely doped layers, and a substrate arranged similarly to those in claim 41. The substrate is

doped throughout with chromium, titanium, and cobalt, such that the doped substrate absorbs the active layer light and emits red, green, and blue light.

**VI. ISSUES**  
(37 C.F.R. §1.192(c)(6))

The issues involved in this appeal follow the examiner's rejections in his Final Office Action dated November 14, 2003, and are as follows:

a. Whether Claim 37 is in improper dependent form under 37 CFR 1.75(c) for failing to further limit the subject matter of the previous claim.

b. Whether Claim 39 is properly rejected under 35 USC §112, first paragraph.

c. Whether Claims 5-7, 14, 24, and 41 are anticipated under 35 USC § 102(b), Japanese Patent 10-056203 (JP'203);

d. Whether Claims 4-7, 14, 15, 24, and 42 are anticipated under 35 USC § 102(e) by U.S. Patent 6,239,901 (Kaneko);

e. Whether Claim 4 is unpatentable under 35 USC § 103(a) for obviousness over JP'203;

f. Whether Claim 9 is unpatentable under 35 USC § 103(a) over Kaneko in view of JP'203;

g. Whether Claims 9, 15, and 42 is unpatentable under 35 USC § 103(a) over JP'203 in view of Kaneko;

h. Whether Claims 30, 31, 33-40, 54, and 55 are unpatentable under 35 USC § 103(a) over either JP'203 or alternatively JP'203/Kaneko, and further in view of U.S. 5,684,309 (McIntosh);

i. Whether Claim 47 is unpatentable under 35 USC § 103(a) over JP'203/McIntosh or alternatively



JP'203/Kaneko/McIntosh, and further in view of U.S. 5,898,185 (Bojarczuk); and

j. Whether Claim 46 is unpatentable under 35 USC § 103(a) over either JP'203/McIntosh or alternatively JP'203/Kaneko/McIntosh, and further in view of the applicant's prior art admissions.

#### **VII. GROUPING OF CLAIMS**

(37 C.F.R. §1.192(c)(7))

Claims 9, 14, 30, 41, and 42 are independent claims.

Claims 4-7, 15, and 24 depend on Claim 14.

Claims 31, 33-40, 46-47, and 54-55 depend on Claim 30.

#### **VIII. ARGUMENT**

(37 C.F.R. §1.192(c)(8)(iii))

##### a. The Examiners Rejections:

Claim 37 is objected to as failing to further limit the subject matter of a previous claim.

Claim 39 stands rejected under 35 USC § 112 as failing the written description requirement;

Claims 5-7, 14, 24, and 41 stand rejected under 35 USC § 102(b) by Nokao, Japanese Patent 10-056203 (JP '203);

Claims 4-7, 14, 15, 24, and 42 stand rejected under 35 USC § 102(a) by the Kaneko '901 patent;

Claim 4 stands rejected under 35 USC § 103(a) as being obvious over the Kaneko '901 patent in view of the JP'203 Patent;

Claim 9 stands rejected under 35 USC § 103(a) as being obvious over Kaneko '901 in view of JP'203;

Claims 9, 15, and 42 stand rejected under 35 USC § 103(a) for obviousness over JP'203 and further in view of Kaneko;

Claims 30, 31, 33-40, 54, and 55 stand rejected under 35 USC § 103(a) as being obvious over either JP'203 or alternatively JP'203/Kaneko, and further in view of McIntosh;

Claim 47 stands rejected under 35 USC § 103(a) as being unpatentable JP'203/McIntosh or alternatively JP'203/Kaneko/McIntosh, and further in view of Bojarczuk; and

Claim 46 stands rejected under 35 USC § 103(a) as being unpatentable over either JP'203/McIntosh or alternatively JP'203/Kaneko/McIntosh, and further in view of the applicants prior art admissions.

b. The Examiner's Rejections Are Erroneous

(1) The Examiner's objection of Claim 37 as Failing to Further Limit the Subject Matter of a Previous Claim is Erroneous and Should be Withdrawn

Claim 37 is objected to under 37 CFR. 1.75(c), as being of improper dependant form for failing to further limit the subject matter of a previous claim. As noted by the Examiner, Claim 30 states in part:

...means for selectively causing each of said plurality of active layers to emit light alone or in combination with others of said plurality of active layers; and

a doped substrate... absorbing at least some of said light from at least one of said plurality of active layers and re-emitting light at a different wavelength.

Claim 37 is intended to further limit Claim 30 by describing the light that can be emitted from the LED from

different LED structures. According to the further limitation, the light emitting from the LED can comprise the "light emitting from at least one of said plurality of active layers or the light emitting from at least one of said plurality of active layers in combination with the light emitted from said doped substrate." This limitation is not included in claim 30 and accordingly Claim 37 further limits the scope of Claim 30. Examiners objection to Claim 37 is erroneous and applicants respectfully request that this rejection be withdrawn.

**(2) The Examiner's Rejection of Claim 39 under 35 USC § 112 As Failing the Written Description Requirement is Erroneous and Should be Withdrawn**

Claim 39 is rejected under 35 U.S.C. 112, first paragraph, as containing subject matter which was not described in the specification in such a way as to enable one skilled in the art to which it pertains, or with which is most closely connected, to use the invention. The Examiner correctly notes that Claim 39 and the portion of the specification associated with the embodiment of FIG. 2 sets forth that when a UV-blue-green, multi-color LED is formed on a substrate that is doped to emit red light (e.g. ruby), the device may be biased to effectively emit only one of red, green, or blue light. In other words, the ruby substrate will re-emit red light upon the absorption of UV light, but will not re-emit red light upon the absorption of blue or green light.

The applicants believe that, based on the applicants' disclosure and drawings, one skilled in the art would be apprised of how to provide a chromium doped substrate so that it emits red light upon absorption of UV light, but not upon the absorption of blue or green wavelengths. The applicants respectfully point out that chromium in sapphire

has an energy level that produces radiative recombination in response to UV and yellow light, but very little in response to blue or green light. The applicants submit that blue or green light will produce mostly non-radiative recombination in chromium doped sapphire.

In this case the inventors fully understand the principals of operation for the inventions claimed herein and applicants submit that these principals have been duly disclosed in the specification. However, even if we assumed, for argument sake alone, that the inventors did not, for sufficient disclosure the inventors need only teach how to obtain the claimed result. The inventors do not need to disclose the scientific principals as to why the invention works. Fromson v. Advance Offset Plate, Inc., 720 F.2d 1565, 219 U.S.P.Q. 1137 (Fed. Cir. 1983).

Thus, the applicants believe that the Examiner's rejection of Claim 39 under 35 USC § 112 as failing the written description requirement is erroneous. Applicants request that this rejection be withdrawn.

**(3) The Examiner's Rejection Of Claims 5-7, 14, 24, and 41 As Anticipated By JP '203 Is Erroneous; The Examiner Failed to Address The Claim Elements In His Rejection and JP'203 Does Not Provide Sufficient Disclosure to Anticipate These Claims**

Claims 5-7, 14, 24, and 41 were rejected as being anticipated by JP'203 under 35 USC 102(b) and of these claims, claims 14 and 41 are independent claims from which the other claims depend.

A claim is anticipated only if each and every element as set forth in the claim is found, either expressly or inherently described, in a single prior art reference. Verdigal Bros. V. Union Oil Co. of California, 814 F.2d

628, 631, 2 USPQ2d 1051, 1053 (Fed.Cir. 1987). The identical invention must be shown in as complete detail as is contained in the . . . claim. Richardson v. Suzuki Motor Co., 868 F.2d 1226, 1236, 9 USPQ2d 1913, 1920 (Fed.Cir. 1990).

The examiner found that the rejected claims are anticipated by JP'203 and in reaching this conclusion the examiner referenced several paragraphs in JP'203. In referencing these paragraphs, however, the examiner failed to address the elements of the rejected claims, instead, providing some of which seems to have no relevance to the rejected claims. For example, claim 14 includes the following limitation:

"said substrate doped through with a plurality of impurities such that said impurities simultaneously absorb the light of said active layer and each re-emits a respective color of light."

The examiner failed to show where this limitation is found in JP '203 and instead, the examiner relied on a stream of references that do not address this limitation.

This is only one example of how the examiner has failed to address the specific claim elements. It has been the applicants' contention through the extended prosecution of these claims that JP' 203 does not disclose, teach or suggest the limitations of the rejected claims and the examiner has not shown where these elements can be found. Applicants submit that the examiner failed in his burden to show that JP '203 anticipates these claims and for this reason alone, applicants request that the rejection of these claims be withdrawn.

It has also been applicant's contention through the prosecution of these claims that JP '203 does not contain a sufficient disclosure such that it can anticipate these rejected claims. For a rejection under 102(b) to be proper, the prior art must provide an enabling disclosure. "In

determining that quantum of prior art disclosure which is necessary to declare an applicant's invention 'not novel' or 'anticipated' within section 102, the stated test is whether a reference contains an 'enabling disclosure'..." *In re Hoeksema*, 399 F.2d 269, 158 USPQ 596 (CCPA 1968). "[A] § 102(b) reference must sufficiently describe the claimed invention to have placed the public in possession of it . . . [E]ven if the claimed invention is disclosed in a printed publication, that disclosure will not suffice as prior art if it was not enabling." Paperless Accounting, Inc. v. Bay Area Rapid Transit Sys. 804 F.2d 659, 665, 231 USPQ 649, 653 (Fed.Cir, 1986). "An enabling disclosure is not 'tossing out the mere germ of an idea' but the provision of 'reasonable detail . . . in order to enable members of the public to understand and carry out the invention." United States Filter Corp. v. Ionics Inc., 68 F.Supp.2d 48, 65, 53 USPQ2d 1071, 1085 (D.Mass 1999

JP'203 does not provide an enabling disclosure with respect to the rejected claims herein members of the public was not in possession of the claimed invention before the date of the claimed invention. JP '203 is void of any detail, much less providing "reasonable detail" and there is certainly insufficient detail to allow members of the public to carry out the invention.

Independent Claim 14 herein recites that "the substrate is doped throughout with **a plurality of impurities** such that the impurities simultaneously absorb the light of the active layer and **each re-emits a respective color of light**". Independent Claim 41 recites *inter alia*, that "the substrate is doped throughout with a **plurality of impurities** such that the substrate absorbs the light from the active layer and re-emits **more than one color of light**".

The light emitting devices as illustrated in FIGS. 1-4 of JP'203 and described in the specification comprise two electrodes which cause the LED to emit UV light from the active area. The UV light causes radiative recombination with a dopant included in the substrate. The dopant can be chosen to provide a desired color of light. Hence, the LEDs emit a color of light based on the type of dopant included in the substrate. This is the focus of JP '203.

The embodiments in JP'203 exemplify using separate substrates to emit different colors. For example, JP'203 teaches that to emit different colors of light, **different** substrates can be doped with the appropriate impurity to provide a desired wavelength of light (See Paragraph 13). JP'203 states that "while green and the light emitting device 1 which emits the light 5 of **one** color of blue can be obtained and the light emitting device of **each color of red, green and blue can be easily manufactured according the same manufacturing process** when the radiant power output of the light emitting device of **each color of red, green, and blue** and adjustment brightness can be performed easily, **arrange many light emitting devices of each [these] color and perform a color display**, the balance of each color can obtain the display which can display a good quality picture image".

JP'203 describes substrates 2, 11, and 21 as "the transparent hard substrate by which the element (photogenesis pin center, large element) which emits the light of the color of either red, green, **or** blue as this substrate 2 (11 or 21) in response to the light of the ultraviolet radiation (wavelength of 250-410 nm) emitted by the semiconductor light emitting device was doped is used". This statement is found in conjunction with Drawing 1 in paragraph 10, Drawing 2 in Paragraph 18, Drawing 3 in Paragraph 21, and Drawing 4 in Paragraph 25. The above

descriptions and phrases indicate that JP'203 is intended to emit only one of red, green, or blue light in response to UV light and did not intend to emit combinations of red, green, and blue light from a single substrate.

To support his conclusion that JP '203 shows the elements of the rejected claims that the examiner cited Paragraph 10 of JP '203 as follows:

...The light-emission center element added to the substrate base material is an element, that when uniformly distributed throughout the base emits light of the color, red, green, or blue when [exposed to] ultraviolet emitted by semiconductor light-emitting element 3; examples are one, or two or more, [elements] selected from transition elements such as Cr, Ti, Fe, V, Cu, the rare earth elements...and Y. (emphasis added by examiner)

He then combined Paragraph 10 with Paragraph 14, which provides as follows:

...By employing as substrate 2 a sapphire substrate containing at least one of element selected from the group consisting of Cr, Fe, Ti, V, Cu, and rare earth elements, it becomes possible to produce on substrate a satisfactory semiconductor light-emitting element 3 comprising a light-emitting layer of [GaN-based materials...] or the like. (emphasis added by examiner)

Applicants submit that these paragraphs fail to show the elements of the rejected claims. For example, Claim 14 includes the limitation that, "the substrate is doped throughout with a **plurality of impurities** such that the impurities simultaneously absorb the light of the active layer and **each re-emits a respective color of light**". The



JP '203 paragraphs relied upon by the examiner do not show this element. Instead, the first paragraph indicates that the substrates are doped to emit "red, green or blue" in response to UV light. This is consistent with the illustrations in JP '203 that show devices having substrates emitting a single color of light. The second paragraph only adds that "at least one" of the elements can be added to the substrate. There is no description or illustrations of a device wherein the substrate emits respective colors of light from a plurality of impurities.

Applicants, quite frankly, find it difficult to determine exactly what is meant by the referenced paragraphs of JP' 203. For instance, it is unclear what is meant by the statement "becomes possible to produce on substrate a satisfactory semiconductor light-emitting element 3 comprising a light-emitting layer of [GaN-based materials...] or the like." In light of the fact that these paragraphs are essentially incomprehensible and JP'203 does not include illustrations to support the examiner's interpretation of these paragraphs, JP' 203 fails to show the elements of the rejects claims.

Even if we were to assume, for argument sake alone, that JP '203 mentioned the elements of the rejected claims, there is no detail that would enable members of the public to understand and carry out the invention. At best, the statements in JP '203 would be "tossing out the mere germ of an idea." There is no guidance in JP '203 to provide the applicants claimed invention and there are no working examples.

Applicants submit that JP '203 cannot be relied upon to reject the claims herein. For at least these reasons, Claims 14 and 41 are allowable over JP'203. Claims 5-7, and 24 are also allowable over JP'203 since they depend from Claim 14. Applicants respectfully request that the rejection of these claims be withdrawn.

**(4) The Examiner's Rejection Of Claims 4-7, 14, 15, 24, and 42 As Anticipated By The Kaneko '901 Patent Is Erroneous; The Examiner Again Ignored the Claim Elements and Kaneko Does Not Disclose, Teach or Suggest The Claim Elements**

Claims 4-7, 14, 15, 24 and 42 were rejected as being anticipated by Kaneko and of these claims, Claims 14 and 42 are independent claims from which the other claims depend. This reference has been repeatedly cited by the examiner to reject various claims through our prosecution of the present application. Applicants have been required to meet these rejections with repeated arguments as to why the rejections are improper, some of the same arguments being presented below. In response to the applicant's arguments through prosecution the examiner withdrew his 35 U.S.C. 102 rejections based on this reference and instead relied on it to make 35 U.S.C. 103 rejections. However, in his final office action the examiner, for unknown reasons, changed his position and again asserted a 35 U.S.C. 102 rejection based on this reference. It has been this type of seemingly complete changes in the examiner's position that has contributed to the convoluted and confusing prosecution of this case.

Like the rejections above, applicants submit that the examiner again failed to address the elements of each of the claims. It has been the applicants' contention through the extended prosecution of these claims that Kaneko does not disclose, teach or suggest the limitations of the rejected claims and the examiner has not shown where these elements can be found. Specifically, and as mentioned above, claim 14 includes the following limitation:

"said substrate doped through with a plurality of impurities such that said impurities simultaneously

absorb the light of said active layer and each re-emits a respective color of light."

The examiner did not show where this element is disclosed in Kaneko. Applicants submit that the examiner failed in his burden to show that Kaneko anticipates these claims and for this reason alone, applicants request that the rejection of these claims be withdrawn.

Applicants also submit that Kaneko does not anticipate the rejected claims. Kaneko discloses a laser device that is very different from the applicant's LED and is designed to solve a very different problem. Applicant's LED is designed to overcome the problem's associated with generating different colors from LED's made from the nitride based material system (although it is equally applicable to LEDs from other material systems).

Kaneko, on the other hand, discloses a hybrid laser device in which the excitation source and solid-state laser are fabricated in the same device in precise alignment with one another. [col. 1, lines 14-50]. In each of the embodiments, the light source provides light to the laser's optical substrate. Mirrors are included on the substrate to reflect the light within the substrate to generate stimulated coherent laser light emission.

The embodiment shown in FIG. 2 of Kaneko is an edge emitting light source 1 that includes a solid state laser 912 with an LED emitter on top of it. The laser 912 is formed of an  $\text{Al}_2\text{O}_3$  crystal substrate 11 having end face mirrors 121, 122 and a bottom mirror 123.  $\text{Cr}^{3+}$  is doped in the crystal substrate 11, which acts as the solid state laser. Light is generated in LED 912 and light from the LED 912 passes into the optical crystal substrate 11 where it undergoes wavelength conversion. The light then reflects between the mirrors 121, 122 to produce stimulated emission of the light  $L_{12}$  through mirror 121. [col. 3, line 7 to col. 4, line 18]. Kaneko notes that although an LED

is use as the light emitter, a laser can be used in its place. [col. 4, lines 43-47]. However, regardless of which light source is used, the light is first generated and then passes into the optical crystal where the mirrors cause stimulated laser emission.

The other embodiments disclosed in Kaneko essentially have the same features with small variations. For instance, the embodiment in FIG. 3 is the same as FIG. 2 except that it has top and bottom mirrors 222, 221 and the stimulated emission of light  $L_{22}$  passes from the device 2 through the bottom 221. The embodiment in FIG. 4 is the same as FIG. 3 with a variation to the LED 932 on the optical crystal. A convex lens 35 is included between the LED 932 and the optical crystal. The only difference in the embodiment of FIG. 5 is that it shows a solid-state laser 942 used in place of an LED to provide light that pumps the solid state laser 941 below it. Similarly, the embodiment shown in FIG. 7 uses a laser emitter 962 that is arranged in a notch in the optical crystal 61. The optical crystal 61 between mirrors 622 and 621 functions as the laser crystal causing stimulated emission from mirror 621. The embodiments in FIGS. 8, 9 and 10 provide variations of the light emitter in FIG. 7.

All of the embodiments have one feature in common, they all rely on a light source applied to an optical substrate with mirrors to generate stimulated emission. Even Kaneko's independent claim 1, from which all other claims depend, requires that the light source have mirrors. Kaneko does not disclose, teach or suggest an LED with a doped substrate where the substrate does not have mirrors to provide laser emission.

Applicants' light source does not use an LED or laser emitter to pump a solid state laser that may have materials to change the wavelength of light, as disclosed by Kaneko. Further, applicants' light source does not use mirrors to

generate laser stimulated emission. Instead, applicants' claimed invention generally comprises the emitter layers formed on a doped substrate such that the substrate absorbs at least some of said light from said active layer and re-emits light at a different wavelength. The LED then emits a combination of light from said substrate and said active layer. Kaneko does not disclose, teach or suggest using this arrangement.

For at least these reasons, Claims 14 and 42 are not allowable over Kaneko. Claims 4-7, 15, and 24 depend from claim 14 and are also allowable over Kaneko. Applicants respectfully request that the rejections of these claims be withdrawn.

**(5) The Examiner's Rejection of Claim 4 as Being Obvious in View of JP '203 Is Erroneous and Should be Withdrawn**

The Examiner rejected Claim 4 under 35 U.S.C. 103(a) as being obvious in view of JP '203 as applied to the claims above. The applicants point out that claim 4 depends from claim 14. As discussed in detail above, claim 14 is allowable over JP' 203 and Kaneko, and as a result claim 4 is allowable as depending from an allowable independent claim. Applicants respectfully request that this rejection be withdrawn.

**(6) The Examiner's Rejection of Claim 9 as Being Obvious Over Kaneko in View of JP '203 Is Erroneous and Should be Withdrawn**

The Examiner rejected Claim 9 under 35 U.S.C. 103(a) as being obvious over Kaneko in view of JP '203. The

applicants believe that claim 9 is not obvious in view of any combination of JP'203 and Kaneko. Independent claim 9 *inter alia*, states that "said active layer emits yellow light and said substrate comprises sapphire doped with chromium, said substrate absorbing some of said yellow light and re-emitting red light".

JP'203 and Kaneko do not teach, disclose, or suggest providing a light emitting diode with an active layer which emits yellow light as disclosed by the applicants. They also do not teach, disclose, or suggest emitting red light in response to the yellow light. JP'203 teaches primarily UV active layers and, in fact, JP'203 states specifically (See Paragraphs 4 through 6 in the Problems to be Solved section) that they are trying to avoid using alloys of the InGaN material system to provide colors of light. They instead want to provide a color of light in response to UV light. Hence, JP'203 wants to avoid using an active layer that emits yellow light because "it needed to adjust semiconductor composition precisely, and needed to manufacture it, the manufacture top various distress was accompanied by it, the cost became very high by it...".

As discussed above in conjunction with the Section 102(b) rejection, Kaneko teaches a hybrid laser device used to pump another laser device. Kaneko does not disclose, teach or suggest using the device structure as disclosed by the applicants. Instead, Kaneko focuses on using a light source to pump a solid-state laser which includes and optical crystal and mirrors. It is well-known in the art that the fabrication of mirrors is difficult, time consuming, and costly because the mirrors need to have precisely controlled reflectivities at various wavelengths. Hence, there are definite advantages with providing a device without mirrors.

Further, the Examiner did not cite a disclosure or suggestion that these references be so combined. "It is

impermissible to use the claimed invention to serve as an instruction manual or template to piece together the teachings of the prior art so that the claimed invention is rendered obvious." In re Fritch, 23 U.S.P.Q.2d 1780 (Fed. Cir. 1992). "The mere fact that the prior art could be so modified would not have made the modification obvious unless the prior art suggested the desirability of the modification." In re Gordon, 733 F.2d 900, 221 U.S.P.Q. 1125 (Fed. Cir. 1984). Thus, the applicants believe that the Examiners 103(a) rejection of Claim 9 is erroneous.

**(7) The Examiner's Rejection of Claims 9, 15, and 42 as Being Obvious in View of JP '203 in View of Koneko is Erroneous and Should be Withdrawn**

Claims 9, 15, and 42 were rejected as being unpatentable over Kaneko '901 in view of JP' 203 as applied to the claims above. The applicants respectfully point out that claims 9 and 42 are independent claims and claim 15 is a dependent claim depending from claim 14.

As fully discussed above, the applicants believe that JP'203 lacks sufficient enabling disclosure to anticipate or make obvious claim 14. This same argument can be applied to claim 9. Accordingly, JP '203 lacks sufficient enabling disclosure to be combined with Kaneko '901 to reject claims 9 and 14. In addition, Kaneko '901 cannot be relied upon alone to render these claims obvious because, as correctly noted by the Examiner, the embodiments in Kaneko '901 use mirrors to produce directional, coherent emission of the secondary light produced in the substrate. Kaneko '901 focuses on using a light source to pump a solid-state laser, which includes an optical crystal and mirrors.

Claim 42 is similar to claim 14 but states *inter alia*, "the substrate is doped throughout with chromium, titanium, and cobalt". The doped substrate absorbs the active layer

light and emits red, green, and blue light. The same argument above regarding rejection of claim 14 also shows that JP '203 does not provide an enabling disclosure of claim 42 and JP '203 cannot be combined with Kaneko to render claim 42 obvious.. Hence, applicants submit that the devices disclosed in Kaneko cannot be combined with the non-enabling disclosure of JP'203 to produce the applicant's claimed invention. Further, the Examiner did not cite a disclosure or suggestion that these references be so combined. Thus, the applicants believe that the Examiners rejection of claims 9 and 42 is erroneous and that these claims are allowable. Claim 15 is allowable as depending from allowable claim 14. Applicant respectfully requests that these claim rejections be withdrawn.

**(8) The Examiner's Rejection of Claims 30, 31, 33-40, 54, and 55 as Being Obvious in View of JP '203 or Alternatively JP '203/Koneko, and Further in View of McIntosh '309 is Erroneous and Should be Withdrawn**

Claims 30, 31, 33-42, 54 and 55 were rejected as being unpatentable over JP '203 or JP '203/Kaneko as applied to the claims above and further in view of McIntosh '309. The applicants respectfully point out that Claim 30 is an independent claim through which claims 31, 33-42, 54, and 55 depend either directly or indirectly.

Independent claim 30 recites *inter alia*, "a means for selectively causing each of said plurality of active layers to emit light alone or in combination with others of said plurality of active layers" and "said substrate absorbing at least some of said light from at least one of said plurality of active layers and re-emitting light at a different wavelength". Hence, if the substrate is doped to emit red/green light, then it can emit red light only, green light only, or a combination of red/green light.



As discussed above all of the figures and examples in JP'203 exemplify a single LED with two electrodes and a substrate doped with a single type of impurity to provide a desired color of light. The only way JP'203 can provide more than one color of light is to separately fabricate a red light emitting device on one substrate and a green light emitting device on another substrate, for example. JP'203 states in Paragraph 14 that "it is possible to constitute the display for color displays by forming many photogenesis units **which become** the same substrate from the substrate fraction which emits light in the color of either red, green, and blue by the light emitted from the aforementioned semiconductor light emitting device and this semiconductor light emitting device". Hence, to provide multiple colors, multiple substrates are fabricated separately then positioned close together to provide a color display.

JP'203 does not provide any working examples or discussion of forming an LED on a single substrate using multiple types of impurities where the impurities can selectively emit light. Even if JP'203 did disclose including multiple dopants in a single substrate, JP'203 does not teach, disclose, or suggest any structure whatsoever for selectively emitting a desired color of light.

The only way JP'203 can emit different combinations of light is by changing the impurity in the substrate. As stated in Paragraph 29, "...any of the colors red, green, or blue can be obtained by using a semiconductor light-emitting element of the same structure by **changing** the light-emission center element in the substrate..." Hence, to change the color being emitted, JP'203 teaches that another substrate should be provided which includes another dopant.

JP'203 fails to disclose, teach or suggest the elements of claim 30 and, consequently, JP'203 cannot

anticipate or make obvious the rejected claims. In fact, JP'203 provides no details whatsoever for a means for selectively emitting light and only mentions the possibility of forming a display from multiple substrates.

Further, McIntosh does not disclose, teach or suggest having a substrate that is doped to absorb light from the active layers to emit another wavelength of light. Instead, discloses an emitter having two active layers stacked on a substrate that claim to emit a white light combination of light from the active layers. It discloses another emitter having three active layers that claim to emit a white light combination of light. Different embodiments are shown where the individual ohmic contacts are provided so that the active layers can vary in intensity as a function of the individual biases.

JP '203 does not disclose, teach or suggest an LED with multiple active layers stacked on a doped substrate. The Examiner has not provided a reference that teaches or suggests that these references could or should be combined.

As a result, neither JP '203 or Kaneko disclose important elements of claim 30 and claim 30 is allowable over these reference. Claims 31, 33-42, 54, and 55 are allowable since they depend from independent claim 30. Applicants request that these rejections be withdrawn.

**(9) The Examiner's Rejection of Claim 47 as Being Obvious in View of JP '203/McIntosh or Alternatively JP '203/Kaneko/McIntosh, and Further in View of Bojarczuk, Jr. et al '185 is Erroneous and Should be Withdrawn**

Claim 47 is rejected as being obvious in view of JP '203/McIntosh or alternatively JP '203/Kaneko/McIntosh, and further in view of Bojarczuk, Jr. et al '185. The applicants respectfully point out that Claim 47 depends from allowable independent Claim 30 and as a result is also

allowable. Applicants request that this rejection be withdrawn.

(10) The Examiner's Rejection of Claim 46 as Being Obvious in View of JP '203/McIntosh or Alternatively JP '203/Kaneko/McIntosh, and Further in View of the Applicant's Prior Art Admissions is Erroneous and Should be Withdrawn

The applicants point out that claim 46 is a dependent claim depending from allowable independent claim 30 and is also allowable. Applicants request that this rejection be withdrawn.

#### CONCLUSION

Applicants submit that the examiner's rejections should be withdrawn and respectfully request a timely Notice of Allowance be issued in this case.



**IX. APPENDIX**  
(37 C.F.R. § 1.192(c)(9))

**The Claims Involved In The Appeal**

4. The LED of claim 14, wherein said active region comprises multiple quantum wells or single quantum wells.

5. The LED of claim 14, wherein said substrate comprises a material from the group consisting of sapphire, spinel, silicon carbide, gallium nitride, quartz YAGI, garnet, lithium gallate, lithium niobate, zinc oxide, and oxide single crystal.

6. The LED of claim 14, wherein said substrate is doped with a plurality of rare earth or transition elements.

7. The LED of claim 14, wherein said substrate is doped with a plurality of impurities from the group consisting of chromium, titanium, iron, erbium, neodymium, praseodymium, europium, thulium, ytterbium and cerium.

9. A light emitting diode (LED), comprising:  
an active layer;

a pair of oppositely doped layers on opposite sides of said active layer which cause said active layer to emit omnidirectional light at a predetermined wavelength in response to an electrical bias across said doped layers;  
and

a doped substrate, said active and doped layers disposed successively on said substrate such that said substrate absorbs at least some of said light from said active layer and re-emits omnidirectional light at a

different wavelength, said LED emitting a combination of light from said substrate and said active layer, wherein said active layer emits yellow light and said substrate comprises sapphire doped with chromium, said substrate absorbing some of said yellow light and re-emitting red light.

14. A light emitting diode (LED), comprising:  
an active region;

a pair of oppositely doped layers on opposite sides of said active layer which cause said active region to emit light at a predetermined wavelength in response to an electrical bias across said doped layers; and

a doped substrate, said active region and doped layers disposed successively on said substrate such that said substrate absorbs at least some of said light from said active region, said substrate doped throughout with a plurality of impurities such that said impurities simultaneously absorb the light of said active region and each re-emits a respective color of light.

15. The light emitting device of claim 14, wherein said active layer emits UV light and said substrate is doped throughout with chromium, titanium, and cobalt, said doped substrate absorbing said UV light and emitting red, green, and blue light.

24. The LED of claim 14, wherein said doped substrate is doped using solid state diffusion, ion implantation, beam evaporation, sputtering, or laser doping.

30. A nitride based light emitting diode, comprising:  
a plurality of active layers each of which is capable of emitting light at a predetermined wavelength;  
a means for selectively causing each of said plurality of active layers to emit light alone or in combination with others of said plurality of active layers;  
and  
a doped substrate, said plurality of active layers arranged vertically on said substrate with a plurality of doped semiconductor layers with each of said active layers sandwiched between two doped layers, said substrate absorbing at least some of said light from at least one of said plurality of active layers and re-emitting light at a different wavelength.

31. The LED of claim 30, that emits a combination of light from said plurality of active layers and said substrate.

33. The LED of claim 30, wherein each of said plurality of active layers comprises multiple quantum wells, single quantum wells or double heterostructures.

34. The LED of claim 30, wherein said substrate comprises a material from the group consisting of sapphire, spinel, silicon carbide, gallium nitride, quartz YAGI, garnet, lithium gallate, lithium niobate, zinc oxide, and oxide single crystal.

35. The LED of claim 30, wherein said substrate is doped with at least one rare earth or transition element.

36. The LED of claim 30, wherein said substrate is doped with at least one impurity from the group consisting of chromium, titanium, iron, erbium, neodymium, praseodymium, europium, thulium, ytterbium and cerium.

37. The LED of claim 30, wherein said means for causing each of said plurality of active layers to emit light being capable of causing different ones of the active layers to emit light such that the light emitting from said LED comprises the light emitting from at least one of said plurality of active layers or the light emitting from at least one of said plurality of active layers in combination with the light emitted from said doped substrate.

38. The LED of claim 30, wherein said plurality of active layers comprises three active layers emitting blue, green and UV light respectively, said substrate comprising sapphire doped with chromium which absorbs said UV light and re-emits red light, said LED emitting blue, green, UV and red light from said substrate, in a white light combination, when all said active layers are emitting.

39. The LED of claim 30, wherein said plurality of active layers comprises three active layers emitting blue, green and UV light respectively, wherein each of said active layers can selectively emit light, said LED emitting primarily red, green, or blue light when one of said active layers is emitting, or said LED emitting primarily purple, aqua, yellow, or white light when more than one of said active layers is emitting.

40. The LED of claim 30, wherein said plurality of active layers comprises two active layers emitting blue and yellow light respectively, said substrate doped with chromium such that it absorbs at least some of said yellow light and emits red light.

41. A light emitting diode, comprising:  
an active layer;

a pair of oppositely doped layers on opposite sides of said active layer which cause said active layer to emit light at a predetermined wavelength in response to an electrical bias across said doped layers; and

a doped substrate, said active layer and doped layers arranged in a stack on said substrate, said substrate absorbing at least some of said light from said active layer and re-emitting light at a different wavelength, said substrate doped throughout with a plurality of impurities such that said substrate absorbs the light from said active layer, and re-emits more than one color of light.

42. A light emitting diode, comprising:

an active layer;

a pair of oppositely doped layers on opposite sides of said active layer which cause said active layer to emit light at a predetermined wavelength in response to an electrical bias across said doped layers; and

a doped substrate, said active layer and doped layer arranged in a stack on said substrate such that said substrate absorbs at least some of said light from said active layer and re-emits light at a different wavelength, and wherein said substrate is doped throughout with chromium, titanium, and cobalt, said doped substrate absorbing said active layer light and emitting red, green, and blue light.

46. The LED of claim 30, wherein said plurality of active layers emit blue light and UV light, said substrate absorbing at least some of said UV light and re-emitting red light, said LED further comprising downconverting material around the surface of said LED that absorbs some of said blue light emitting from that surface and re-emits yellow light.



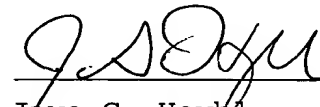
47. The LED of claim 30, further comprising electrical circuitry integrated with said LED on a common substrate.

54. The LED of claim 30, wherein said means for causing each of said plurality of active layers to emit light comprises an n-type layer and a plurality of p-type layers, said n-type layer disposed between the first of said vertically arranged active layers and said substrate, said p-type layers and successive active layers alternating on said first of said active layers, with a p-type layer being the top layer, said plurality of active layers separately emitting light by causing a bias to be applied across said n-type layer and one of said plurality of p-type layers.

55. The LED of claim 54, wherein said means for causing each of said plurality of active layers to emit light further comprises an n-type layer contact and a plurality of p-type layer contacts, said n-type layer contact contacting said n-type layer and each of said plurality of p-type contacts contacting a respective one of said plurality of p-type layers.

Respectfully submitted,

Dated: March 13, 2004



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